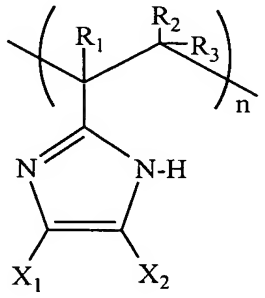
CLAIMS

1. A proton exchange membrane for a fuel cell wherein the proton exchange membrane comprises:

a polyimidazole polymer of the type:



wherein R_1–R_3 are independently H, a halogen, alkyl, or substituted alkyl; and wherein X_1 and X_2 are independently H or an electron withdrawing group.

2. The membrane of claim 1, wherein R_1–R_3 are independently H or a C_1-C_5 alkyl.

3. The membrane of claim 1, wherein at least one of X_1 and X_2 is an electron donating group.

4. The membrane of claim 1, wherein X_1 and X_2 are independently: NR_3^+, SR_2^+, NO_2, SO_2R, CN, SO_2Ar, COOR, NRCOR, OR, SR, C≡CR, Ar, CR=CR_2; wherein R is: H, alkyl, or substituted alkyl, and wherein Ar is an aromatic group.

5. The membrane of claim 1 further including a polar solvent dissolved therein.

6. The membrane of claim 5 wherein said polar solvent is selected from the group consisting of N-methylpyrrolidone, dimethylformamide, dimethylsulfoxide, and combinations thereof.

7. The membrane of claim 1, further including a dopant.

8. The membrane of claim 7, wherein said dopant comprises a strong acid.

9. The membrane of claim 8, wherein said strong acid is selected from the group consisting of nitric acid, phosphoric acid, polyphosphoric acid, sulfuric acid, and combinations thereof.

10. The membrane of claim 8, wherein said strong acid is an organic acid.

11. The membrane of claim 1, wherein said polymer has a molecular weight in the range of 5×10^3-10^7 daltons.

12. The membrane of claim 1, wherein said membrane has a thickness in the range of 25-200 microns.

13. The membrane of claim 1, wherein said membrane has an electrical conductivity greater than 0.01 S/cm.

14. The membrane of claim 1, wherein said polyimidazole polymer is copolymerized with an acidic monomer.

15. The membrane of claim 14, wherein said acidic monomer is an acidic vinyl monomer.

16. The membrane of claim 15, wherein said acidic vinyl monomer is selected from the group consisting of: vinyl phosphonic acid, vinyl sulfonic acid, styrene sulfonic acid, and combinations thereof.

17. The membrane of claim 1, wherein R_1–R_3 are fluorine.

18. The membrane of claim 1, further including a heteropolyacid.

19. The membrane of claim 18, wherein said heteropolyacid is selected from the group consisting of: monododecylphosphate, phosphotungstic acid, silicotungstic acid, phosphomolybdic acid, and combinations thereof.

20. The membrane of claim 18, wherein said heteropolyacid is adsorbed on a carrier which is dispersed in said polymer.

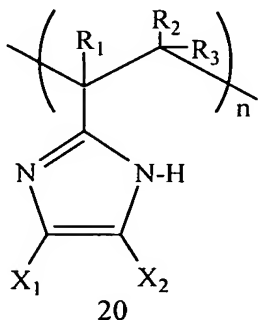
21. The membrane of claim 20, wherein said carrier comprises silica.

22. The membrane of claim 1 further including a silicon compound therein.

23. The membrane of claim 22, wherein said silicon compound comprises SiO_2.

24. The membrane of claim 22, wherein said silicon compound comprises a network of –Si–O–Si– which extends through at least a portion of said membrane.

25. A fuel cell having a proton exchange membrane, said membrane comprising a polyimidazole polymer of the type:



wherein R_1–R_3 are independently H, a halogen, alkyl, or a substituted alkyl; and wherein X_1 and X_2 are independently H or an electron withdrawing group.

26. The fuel cell of claim 25, wherein X_1 and X_2 are each CN.

27. The fuel cell of claim 25, wherein said membrane further includes a polar solvent dissolved therein.

28. The fuel cell of claim 25, wherein said membrane further includes a dopant therein.

29. The fuel cell of claim 25, wherein said dopant comprises a strong acid.

30. The fuel cell of claim 29, wherein said strong acid is selected from the group consisting of nitric acid, phosphoric acid, polyphosphoric acid, sulfuric acid, and combinations thereof.

31. The fuel cell of claim 25, wherein said membrane comprises a copolymer of said polyimidazole polymer and another material.